CHAPTER V

DISCUSSION

The impedances and the field patterns are discussed in separate sections as follow:

IMPEDANCE The theoretical and the experimental results, shown in Fig. 4.9 and Fig. 4.10 indicate that, the resistance and reactance obtained from the experiments are less than the theoretical ones. This is because of the increment of the capacitance at the base and near the input regions. It is too complicated to describe the exact solution of these effects. However, the approximate solution of these effect have already been derived by R. King (9). In his derival, King assumed that the capacitance was distributed at the input region and the result for $1/a = 75$ has been shown in Fig. 2.4 and Fig. 2.5.

It was stated that the resistance and the reactance are less than the theoretical ones and this could be roughly verified as follow:

When disregarding the base and the near base capacitance. The input impedance (Z) equals to the theoritical value, that is

$$Z = R + jX \qquad (88)$$

However, when these effects are taken into account, the input impedance becomes (Z_1) for which

$$\frac{1}{Z_1} = \frac{1}{Z} + jwC \qquad (89)$$

$$Z_1 = \frac{R}{(1-wCX)^2 + wCR^2} + j\frac{X}{(1-wCX)^2 + \frac{wCR}{1-wCX}^2} - \frac{j}{(1-wCX)^2 + 1}$$

$$\approx \frac{R}{(1-wCX)^2 + wCR^2} + j\frac{}{(1-wCX)^2 + \frac{wCR}{1-wCX}^2} \qquad (90)$$

$$= MR + jNX \qquad (91)$$

$$= R_1 + jX_1 \qquad (92)$$

From eq.(90), it is evident that M,N are always less than one or $R_1 < R$; $X_1 < X$, but this will not hold if

$$X > 0; \quad X \approx \frac{1}{wC}\,; \text{ in which } \frac{1}{wC} > R^2 \qquad (93)$$

However, the condition as states in eq.(93) occurs for a very short interval of X.

Therefore, it is seen that for thick cylindrical antenna with relative large junction capacitances, the input impedances become smaller than the theoretical ones where the junction capacitances have not been taken into account.

Fig. 4.7 and Fig. 4.8, the concentric hole on the ground plane has been made to reduce base and the near-base capacitance. As a result of this, the input impedance increased.

From Fig. 4.10, it is noted that the experimental values of resonant length are less than the theoretical ones. This is because of the end effect that lengthens the physical length and has been neglected in theoretical approach.

One of the reasons that caused the experimental values differ from the theoretical results is that, the ground plane used in this experiment is not perfectly ground plane as assumed in the theoretical analysis. From the experimental work carried out by A.S. Meier and W.P. Summer(10)It can be concluded that, the input impedance of the cylindrical stub antenna over a circular ground plane varies from 5 % to 20 % when the diameter of the ground plane varies from 6 λ to 1.5 λ respectively.

From Fig. 4.13, it is seen that the value of the input impedance of the stacked cylindrical antennas is smaller than the impedance of the cylindrical stub antenna. This is due to the paralled circuit which composed of two cylindrical stub antennas and due to the mutual impedance between these two elements. As stated in the first chapter that thereis not any complete satisfactory method of of calculating mutual effect in general, so its effect will not be discussed and it would be left as a potential guidance for the future study.

FIELD PATTERN: The field patterns of the different type of antennas as shown in Fig. 4.21 to 4.25, the half power beam width obtained from those figures are tabulated in table 5.1.

Field pattern from Fig. 4.21, the difference would be caused by the field from the unbalanced feeder and the environmental interference. From Fig. 4.21 to Fig. 4.25, the null points are filled, this is because of the harmonic radiation caused by the harmonic current and because of the stray current at the input region.

Comparision between Fig. 4.22 and Fig. 4.23, as the distance between elements is increased from 0.5 λ to 0.6 λ, the field strengths measured at the null region will also be increased. This owing to the minor lobes that created by the array of 0.6 λ. However, there is also a relative increment of the directivity as the distance between elements is increased from 0.6 λ to 0.5 λ.

Other sources such as environmental interference, the reflected waves and the error of the instruments also cause the experimental values to be different from the theoretical ones.

Table 5.1

The theoretical and experimental values of the half power beam widths of the various antennas

Item	Antenna	Half Power Beam Width (Degree)	
		Theoretical	Experimental
1	Monopole, 0.4 λ length	82	85
2	Stacked cylindrical antennas, without ground plane and distance between elements = 0.5 λ	50	59
3	As stated in 2, but with the distance between elements = 0.6 λ	43	51
4	Stacked cylindrical antennas, with four radial ground rods and the distance between elements = 0.5 λ	28	39
5	As stated in 4, but with the distance between elements = 0.6 λ	25	35